What is claimed is:

[Claim 1] A particle stripping unit for separating particles in suspension with a carrier fluid with a self-stripping disengagement feature, comprising:

a stripping vessel having a primary cyclone;
an inlet to tangentally feed a particulate-fluid suspension to the primary cyclone;
a cylindrical surface within the primary cyclone to separate a major fraction of the particulates from the suspension and form a central fluid vortex of reduced particulate content;
a particulate discharge outlet into the stripping vessel from the primary cyclone;
a plurality of openings in a wall of the primary cyclone for entry of stripping fluid into the primary cyclone from a dilute phase in the stripping vessel; and
a fluid discharge line from the stripping vessel in communication with the vortex of the primary cyclone and sealed against direct fluid entry from the dilute phase.

[Claim 2] The particle stripping unit of claim 1, further comprising a stripping zone between the vortex and the particulate discharge outlet.

[Claim 3] The particle stripping unit of claim 2 wherein the openings in the wall for entry of the stripping fluid are located in the stripping zone.

[Claim 4] The particle stripping unit of claim 1, further comprising a thermal expansion joint in the fluid discharge line.

[Claim 5] The particle stripping unit of claim 2, further comprising a stabilizer between the vortex and the stripping zone forming an annular passage between the stabilizer and an interior surface of the cyclone for downward passage of particulates and upward passage of fluid.

[Claim 6] The particle stripping unit of claim 1, wherein the inlet is connected to a fluid catalytic cracking (FCC) riser to receive a suspension of solid catalyst particles in the vapor.

[Claim 7] A method of operating the particle stripping unit of claim 2, comprising:

supplying the suspension to the inlet;
passing particulates downwardly through a cross-sectional area of a lower portion of the stripping vessel comprising a vertical cylinder at an average solids flux rate of from 24 to 440 kg per square meter of cross-sectional area per second;
introducing stripping fluid into the stripping zone openings at an average fluid velocity of from 9 to 90 meters per second; and
recovering stripped particles from the particulate discharge outlet.

[Claim 8] The method of claim 7, wherein:

the cyclone includes a stabilizer between the vortex and the stripping zone that forms an annular passage between the stabilizer and the interior surface of the cyclone for downward passage of particulates and upward passage of fluid; and
the method includes passing fluid up through the annular passage at a superficial velocity range of 0.1 to 5 meters per second.

[Claim 9] The method of claim 8, wherein:

the solids flux rate is from 70 to 200 kg per square meter of cross-sectional area per second;
the annular superficial fluid velocity is from 0.5 to 5 meters per second; and
the stripping fluid opening velocity is from 37 to 60 meters per second.

[Claim 10] A fluid catalytic cracking (FCC) unit, comprising:

an FCC stripper vessel;
a self-stripping primary cyclone disposed within the stripper vessel to separate catalyst from FCC riser effluent and form a catalyst-lean stream of hydrocarbon vapors;

a catalyst stripping bed in a lower end of the FCC stripper;
an inlet to the primary cyclone to supply the FCC riser effluent to the primary cyclone;
a stripping fluid supply to the stripping bed; and
a stripped catalyst outlet from the stripping bed through the lower end of the FCC stripper.

[Claim 11] The FCC unit of claim 10, wherein the primary cyclone further comprises:

a cyclone vessel;
a cylindrical surface centrally mounted in the primary cyclone to separate solids from the suspension and form a vapor vortex of reduced solids content;
a sealed vapor outlet from the primary cyclone in communication with the vortex;
a solids discharge outlet from a lower end of the primary cyclone; and
a plurality of openings in a wall of the lower end of the primary cyclone for the entry of stripping fluid.

[Claim 12] The FCC unit of claim 11, further comprising a stripping zone between the vortex and the solids discharge outlet.

[Claim 13] The FCC unit of claim 12, wherein the openings in the wall for the entry of stripping fluid are located in the stripping zone.

[Claim 14] The FCC unit of claim 13, further comprising of a thermal expansion joint in the vapor outlet.

[Claim 15] The FCC unit of claim 14, further comprising a stabilizer between the vortex and the stripping zone forming an annular passage between the stabilizer and an interior surface of the primary cyclone for downward passage of solids and upward passage of fluid.

[Claim 16] The FCC unit of claim 11, further comprising a catalyst regenerator, comprising:

a stripped catalyst inlet to the regenerator connected to the solids discharge outlet of the FCC stripper;

a distributor to introduce an oxygen-containing gas into the regenerator to regenerate the stripped catalyst; and
an outlet from the regenerator to transfer regenerated catalyst to an inlet of the FCC riser.

[Claim 17] A method of operating the FCC unit of claim 11, comprising: supplying a vapor-solid suspension from an FCC riser to the inlet of the FCC unit of claim 11;

passing solids down through a cross-sectional area of an lower portion of the cyclone vessel comprising a vertical cylinder at an average flux rate of from 24 to 440 kg per square meter of cross-sectional area per second;
passing fluid upward through the cylinder at a superficial velocity of from 0.06 to 3 meters per second;
introducing stripping fluid into the stripping zone wall openings at an average fluid velocity of from 9 to 90 meters per second; and
recovering stripped particles from the solids discharge outlet.

[Claim 18] The method of claim 17, wherein:

the primary cyclone includes a stabilizer between the vortex and the stripping zone forming an annular passage between the stabilizer and an interior surface of the cyclone for downward passage of particulates and upward passage of fluid; and
the method includes passing fluid upwardly through the annular passage at a superficial velocity of from 0.1 to 5 meters per second.

[Claim 19] The method of claim 18, wherein:

the solids flux rate is from 70 to 200 kg per square meter of cross-sectional area per second;
the annular superficial fluid velocity is from 0.5 to 1.5 meters per second; and
the stripping fluid opening velocity is from 37 to 60 meters per second.

[Claim 20] The method of claim 17, wherein the stripping fluid supply is selected from a source including steam, air, ammonia, flue gas, or mixtures thereof.

[Claim 21] A method for stripping vapor from a suspension of particulates in a carrier gas, comprising:

separating particulates from the suspension in an initial separation zone of a cyclone to form a particulate-rich stream with entrained vapor and a vapor stream lean in suspended matter;
introducing a stripping fluid through openings in an exterior wall of the cyclone into a stripping zone below the initial separation zone;
passing the particulate-rich stream from the separation zone through the stripping zone, making countercurrent contact with the stripping fluid to remove at least a portion of the entrained vapor, and into a dipleg in communication with the stripping zone; and
recovering stripped particulates from the dipleg.

[Claim 22] The method of claim 21 wherein the stripping zone is in fluid communication with the initial separation zone via an annular passage defined by an outside diameter of a vortex stabilizer and an interior wall of the cyclone between the separation and stripping zones.

[Claim 23] A method of retrofitting an existing cyclone to a self-stripping cyclone, wherein the existing cyclone is housed within a pressurized vessel to receive a vapor-solid suspension and separate the suspension into a solids-rich stream and a solids-lean stream, the existing cyclone has a sealed lower discharge to pass the particulates into the pressurized vessel, and the existing cyclone is connected to a plenum in communication with an exterior of the pressurized vessel to recover the solids-lean stream, the method comprising:

installing a new cyclone bottom to an upper portion of the existing cyclone to provide a stripping zone in communication with the upper portion, wherein the new cyclone bottom includes a dipleg to receive the solids rich stream from the stripping zone and a plurality of openings in the wall of the cyclone bottom to introduce stripping fluid into the stripping zone by differential pressure; and
replacing the unsealed joint with a sealed joint, if the plenum of the existing cyclone comprises an unsealed joint.

[Claim 24] The method of claim 23, wherein the new cyclone bottom comprises a vortex stabilizer and an interior wall of the cyclone bottom that defines an annular passage there between.